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## On Operations for Divergent Strabismus,

*Illustrated by Twenty-five Cases.*

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REPRINTED FROM THE  
**New York Medical Journal**  
*for March 11, 1893.*





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ON OPERATIONS FOR  
DIVERGENT STRABISMUS,

ILLUSTRATED BY TWENTY-FIVE CASES.\*

By OREN D. POMEROY, M. D.

CASE I.—Dr. Z., aged thirty-two, had a decided converging strabismus, the right being the fixing eye.

The vision was  $\frac{3}{8}$  + in the right and  $\frac{2}{8}$  in the left. There was slight hypermetropia. Some years since, the left internus was divided by an ophthalmic surgeon and resulted in an absolute loss of power in the muscle, and the eye deviated four lines to the left. I advanced the internus of the left by the old method, although very little tendon could be found, together with the conjunctiva. The externus was freely divided with extensive conjunctival dissection. The right externus was also divided, and the position of the left was at about two lines of convergence. The operation was done under cocaine.

There was very little reaction, and the *status præsens* is one of nearly central position of the left eye, but without mobility, except in a vertical direction. The divergence is perhaps one line.

It will be seen that the operation on the left externus pro-

\* Read before the Medical Society of the State of New York at its eighty-seventh annual meeting.

duced a complete loss of power, which seemed the only way of restoring the normal position of the eye.

CASE II.—Miss R., aged twenty-four, has a divergent strabismus of about two lines. She fixes with either eye, but more frequently with the right. The vision is  $\frac{3}{16}$  in each eye; no improvement with glasses and she seems to be emmetropic. There is no binocular vision. The left internus was advanced by the modified Prince operation, and the right externus was freely divided. Fifteen days afterward there was binocular single vision, although there was exophoria of  $8^{\circ}$  to  $10^{\circ}$  at distance. The left converges the better of the two.

Points of interest: Restoration of binocular single vision, when binocular vision was absent before the operation, and a state of emmetropia. With the vision so nearly perfect in each eye, the restoration of binocular single vision was to be hoped for.

CASE III.—Alice T., aged twenty-five, has divergent strabismus, with vision in the left  $\frac{3}{16}$  and right  $\frac{5}{16}$ ; emmetropic; fixes with the left, and the right diverges three lines. The right internus was advanced and some convergence resulted for a few weeks. Four months subsequently there was a line and a half of divergence and the externus of the right was divided, which resulted in correct position. No binocular vision. This case shows that it would have been better to follow the rule and divide the externus of the deviating eye.

CASE IV.—David E. E., aged twenty-one, has a divergent strabismus of about two lines and a half. The right eye accepts a  $+40$  D. axis  $90^{\circ}$  and has  $\frac{3}{16}$  vision. The left eye is not improved by correction, and has less than  $\frac{2}{16}$  vision. No binocular vision. He has had headaches, nausea, and vertigo, and some conjunctivitis. The wearing of the cylindrical correction over the right eye seems to relieve his symptoms; naturally he fixes with the right eye. There is no apparent weakness of the internus of the fixing eye. He has been wearing a spherico-cylindrical glass for reading, but found it fatiguing. Three months after these observations the externus of the left was divided at its insertion with free conjunctival dissection, without quite correcting the strabismus; a suture was applied deeply in the con-



junctiva near the inner margin of the cornea and attached to the inner canthus, tightened sufficiently to cause two or more lines of convergence. This remained in for two days, when it cut itself out from the conjunctival side. After the tenotomy there was homonymous diplopia for a few days, with a convergence of from  $2^{\circ}$  to  $3^{\circ}$ . In spite of this, the eye seems to turn outward slightly. After about ten days the eye was apparently in correct position. When looking sharply to the left he still sees double. There was no restoration of binocular single vision. I did not attach the suture to the fellow eye across the nose, because it seemed to me that only the internus of the left was weakened. He thinks the strabismus commenced some years since after an inflammation of the eye following vaccination, but no lesion was visible by ophthalmoscopic inspection.

CASE V.—Mary R., aged twenty-one, has a divergence of three lines. The right usually fixes; vision—right eye,  $\frac{2}{x}$ , no correction; left,  $\frac{2}{x}$  with  $-6.50$  D. With this eye there seems to be astigmatism by Javal's test. The patient was etherized and both externi freely divided. A suture attached in the conjunctiva near the inner margin of each cornea and tied across the nose caused a convergence of nearly three lines. Two days afterward there was some œdema of the lids. After six days the eyes were in correct position, except that the left eye inclined to turn out and the right eye slightly to converge. Would it have been better to have placed the stitch only in the left, fastening it to the inner canthus, or to have placed a stitch in each eye, but tightening the left more than the right?

CASE VI.—Kate S., aged nineteen, has divergence of the right eye of two lines and a half, dating back to an injury five years since, when a cataract was produced. Subsequent needling removed the lens, and the vision became  $\frac{2}{x}$ . The field is concentrically limited to an area of  $10^{\circ}$ . The left eye has vision  $\frac{2}{xx}+$ , and a hypermetropia of about  $+1$  D. No binocular vision. Both externi were freely divided and the eyes made to converge two lines and a half by means of a suture tied across the nose. In one week the eyes were in correct position, although the right internus seemed somewhat insufficient.

Would it have been better to have guyed each eye separately to the inner canthus, applying more convergence to the more squinting eye?

CASE VII.—Solomon P., aged seventeen, has divergent strabismus. The right eye fixes and the left deviates about three lines.

Both externi were freely divided, and the right was made to converge about two lines by means of a suture attached to the inner canthus.

After five days the eyes were in correct position. Subject myopic. I am uncertain as to the indications for attaching the correcting suture to both eyes and tying them across the nose. I think I was impressed with the idea that the right internus was much the weaker of the two; no binocular vision.

CASE VIII.—Mary M., aged twenty, has a divergence of the right eye of from three to four lines. She counts fingers with this eye at two feet, and with the left has  $\frac{20}{xx}$  vision. No correction in either eye. The right externus was divided and the internus was advanced by the modified Prince method, leaving the eye convergent about two lines. There was some swelling of the lid, and iced cloths were used for two days. The eye was slightly convergent for ten days, when the position became correct.

CASE IX.—William T., aged forty-nine, has had divergence of the left eye for thirty-one years, dependent, apparently, on a vascular tumor in the superior maxillary region, which also caused an entropion of the lower lid. The divergence was from three to four lines. After various methods of treatment, including ligation of the internal carotid artery, the tumor disappeared. The vision of the left eye was  $\frac{8}{cc}$ , with an atrophic-looking nerve, but a perfect field. The eye protrudes somewhat. The vision of the right is  $\frac{20}{xxx}$ . Both are emmetropic. The left externus was divided and the right was advanced by the modified Prince method, leaving it convergent about two lines. The eye was convergent for six days. On the seventh day the stitch was removed and the eye became straight. A subsequent operation was successfully done for the entropion.

CASE X.—Ella O. B., aged twenty-seven, has myopia and a

divergence of the right eye of four lines. Under cocaine anæsthesia the right internus was advanced by the modified Prince method, and the eye was left convergent about two lines.

This convergence partly remained after a week. No further record.

CASE XI.—Lizzie E., aged seventeen, has a divergence of the right eye of three lines for the past seven years. The vision of the right eye is  $\frac{2}{8}$  with  $-14$  D., and the left  $\frac{2}{L}$ —with  $-8$  D. The right internus was advanced without further operations. In a few days the correcting glasses were worn and the position of the eyes was satisfactory, although if the glasses were removed there was divergence. It might have been better to have divided the right externus. I think this is the only case where *myopic* correction has sensibly influenced the position of the eyes.

CASE XII.—Mr. H. O., aged twenty-five, has divergence of the right eye of three lines and a half. Refraction of the right is  $-8$  D., and the left is emmetropic or has slight hypermetropic astigmatism. The vision of the right is  $\frac{2}{6}$ , and the left  $\frac{2}{XXX}$ —. No binocular vision before or after the operation.

Both externi were divided, and the right internus was advanced by the modified Prince method. At first there was an over-effect, but after a week this disappeared.

CASE XIII.—Mr. H. O., aged twenty-five, has a divergence of the right eye of three lines and a half; both eyes myopic.

The externi were divided, and the right internus was advanced by the modified Prince method, leaving the eye somewhat convergent.

In one week the position was correct, although there was some apparent insufficiency of the right internus.

CASE XIV.—Mary M., aged twenty, has a divergence of the right eye of three lines. The right counts fingers at one foot, and the left has a vision of  $\frac{2}{XX}$ . A modified Prince advancement of the right internus was done, and the externus was divided, leaving the eye somewhat convergent. In a week the position was correct.

CASE XV.—George F., aged fifteen, had divergence of the



left eye. The internus was advanced by the modified Prince operation, and the externus was divided.

Parallelism was the result for a few days, but after three weeks there was decided divergence. Evidently the right externus should have been divided.

No further note.

CASE XVI.—Lizzie N., aged fifteen, has divergence of the right eye. The vision of the right was  $\frac{3}{8}L$  with + 2 D.  $\odot$  + .75 C., axis 75°; and the left was  $\frac{3}{8}X$  with + .75 D., axis 90°. The right internus was advanced by the modified Prince operation, and the externus was divided.

A sufficient effect only was at first obtained, but it remained permanent. It was done under ether, and the effect could not as well be estimated as though cocaine had been used.

CASE XVII.—James R., aged twenty-eight, has a divergence of the right eye of not less than four lines, the result of a tenotomy of the internus. The externus was divided, and the internus was advanced after the old method, as it was feared that, on account of some atrophy of the conjunctiva, there would have been an insufficient amount to properly sustain the pulley suture. The operation was done under ether. The eye converged about two lines for three or four days, when it became parallel. Directly after the operation the cornea was nearly covered by the ocular conjunctiva, the result of the dragging of the sutures. The patient made a good recovery, but with the somewhat prolonged lumpy elevation at the site of the advancement. There is almost normal motility of the eyeball, with some insufficiency of the internus. Contrast this case with Case I, which presented identical conditions apparently, but where there was an absence of horizontal motility of the eyeball.

CASE XVIII.—William A. W. has divergent squint of three lines. Right eye emmetropic; left, myopic — 1.25 D. Advanced the left internus by the modified Prince operation, and divided the externus. As a result there was three lines of convergence, which ultimately disappeared.

CASE XIX.—William T., aged forty-nine, has divergent squint in left eye of three lines. Vision,  $\frac{6}{60}$ , and in the right  $\frac{20}{200}+$ ;



both emmetropic. Left fundus looks atrophic, but the field is perfect.

The left externus was divided, and the internus was advanced by the modified Prince operation. The eye was left slightly convergent.

No further note.

CASE XX.—George F., aged fifteen, has divergence of left eye, I conclude, of no great degree, as it was corrected by division of the left externus, the eye at first being slightly convergent. No suture.

CASE XXI.—Alice F., aged twenty-five, has two lines of divergence of the right eye. Both eyes emmetropic. Vision of the right eye is  $\frac{6}{60}$ , and of the left  $\frac{20}{20}$ .

The tendon of the right externus was divided, and on the next day there was parallelism. No suture used. This seems somewhat unusual.

CASE XXII.—One case, the notes of which I have lost, having a three-line strabismus, was operated on by the old method, and the convergence of two lines after the operation continued for a year afterward. Since that time it has grown so much less as not to be a disfigurement. This is the only case of permanent convergence I have seen as a result of operation. Some of the cases herein reported have been noticed after a year or two to show slight divergence, following the well-known tendency to revert to the original condition.

CASE XXIII.—Another case, in which advancement was done by the old method, resulted in considerable reaction and the cornea became involved. For a time the symptoms were serious; the eye, however, recovered with a small peripheral opacity of the cornea, but without harm to the vision. At the time, another case at the hospital behaved in a similar manner, and the late Dr. Agnew suggested that there might be some septic influence at work in the hospital.

*Mode of Operating.*—The earlier cases were operated on by the old method—that is, the muscle, including the overlying conjunctiva, was advanced and attached to the eyeball by two sutures, passed into the conjunctiva, reach-

ing respectively to the center of the cornea above and below. The end of the tendon was cut off so as not to encroach on the cornea. The objections to this operation were the somewhat excessive traumatism inflicted on the eye, the danger of producing a twist to the eyeball by unequal tightening of the sutures, and a lumpy elevation on the eyeball, the result of the advanced conjunctiva and muscle.

Latterly I have used what has been here denominated the modified Prince operation. The pulley used by Prince and his method of applying the sutures have been retained and nothing more. For some years I have discarded any special method for catching the tendon, finding it amply sufficient to go in with fixation forceps and grasp the tendon. If two forceps are used, the tendon may be more accurately caught. At an earlier date, fearing that the tendon might not easily be found, I was in the habit of attaching the fixation forceps to it before division; but this is not necessary. In one case the pulley was torn out of the conjunctiva and the old operation was substituted, but I suspect the fault was in not passing the suture so as to include a sufficient amount of conjunctiva. If the suture somewhat encroaches on the sclera it does no harm. In my later operations I am inclined to the practice of not advancing the muscle at all, but dividing one or both of the externi and using a suture to draw the eye inward.

In one of the cases here reported, where the suture was attached to both eyes and tied across the nose, the effect was greater on the less squinting eye, which seemed to me an objection to the operation.

It would perhaps have been better to attach each eye separately to the inner canthus, and converge the non-fixing eye more than its fellow. I lay great stress on producing considerable convergence by the sutures; in some cases as much as three lines or more, for the most thorough di-

vision of the externi alone may have little influence on the position of the eyes.

I never have removed a piece of the tendon in this operation, or divided it any distance from its insertion, not having found it necessary. The operations have latterly been done with antiseptic precautions, although before the day of antiseptics little reaction usually resulted. In a few instances iced cloths and atropine have been necessary.

*Recapitulation and Remarks.*—Only two cases were operated on where the squint depended on faulty operation for convergence. In Case I both externi were divided and one internus was advanced by the old method, the result being nearly correct position, but with absolute lateral immobility. In Case XVII advancement was done with division of the externus of the same eye, and the position of the eye was perfect and the mobility was nearly normal.

It is not easy to explain the absence of motility in one case and nearly perfect motility in the other. In Case II there was divergence of two lines, emmetropia, vision  $\frac{5}{16}$  in each; fixes with either eye, and no binocular vision. One internus was advanced and the externus of the fellow-eye divided, with the result of binocular single vision and exophoria of  $8^{\circ}$  to  $10^{\circ}$ .

In Case VIII there was sufficient reaction to require iced cloths to the eye: eye convergent for ten days.

Case X had divergence of four lines and was corrected by advancement only.

In Case XI one internus was advanced with correction of the squint, but in a few days there was relapse and the eyes were kept in position by correcting the myopia of  $-14$  D. in one and  $-8$  D. in the other.

In Case XII Prince's advancement and both externi divided; one eye emmetropic and the other myopic.

In Case XIII Prince's advancement; division of both

externi; both myopic; eyes straight, but some insufficiency of internus of deviating eye.

In Case XIV, emmetropia, squinting eye amblyopic; Prince's advancement, and division of the opponent; at first over-effect, then correct position.

In Case XV the internus was advanced by the Prince method and its opponent was divided; after a few days some divergence; the only case of decidedly insufficient effect in this list.

In Case XVI, hypermetropic astigmatism in one and compound hypermetropic astigmatism in the other; had the internus advanced, its opponent divided, and a correct position obtained, although there was no over-effect at first.

In Case XIX, both emmetropic; Prince's advancement; tenotomy of externus; convergence at first, subsequently slight convergence.

Case XX, slight divergence; emmetropic; corrected by division of externus; no suture.

Case XXI same as Case XX, except one eye was amblyopic.

At the present time I am inclined to the belief that nearly all the cases of divergence may be corrected without advancement. Especial stress should be laid on drawing the eye sharply inward when the squint is excessive, in some cases as much as three or four lines.

In divergence from tenotomy of the internus, advancement will, of course, generally be necessary.

Two additional cases are here appended—one where the squint depended on a previous tenotomy and which was corrected without advancement.

CASE XXIV.—Rose R., aged twenty-two, has a divergence of the left eye of three lines, dependent on an operation for convergent squint some years since; left eye very amblyopic; right, perfect vision with moderate hypermetropia. Division of



left externus, with the use of an adducting suture, which caused nearly three lines of convergence, although after the division of the externus the eye apparently became straight. This suture cut its way out in from two to four days and the eyes are in correct position. It will be seen that this is the only case of divergence dependent on a previous tenotomy of the internus where advancement was not done, yet the operation was entirely adequate.

CASE XXV.—Thomas B., aged forty-nine. Divergence two lines and a half; fixes with left. Vision—right,  $\frac{20}{100}$  with — 6 D.; left,  $\frac{20}{100}$ , emmetropic. Division of externus of the right and an adducting suture attached to the inner canthus, which produced two lines of convergence. In two days the suture cut its way out of the conjunctiva and it was removed. The eyes became parallel.





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